

Multi-Instrument Intercalibration (MIIC) Status

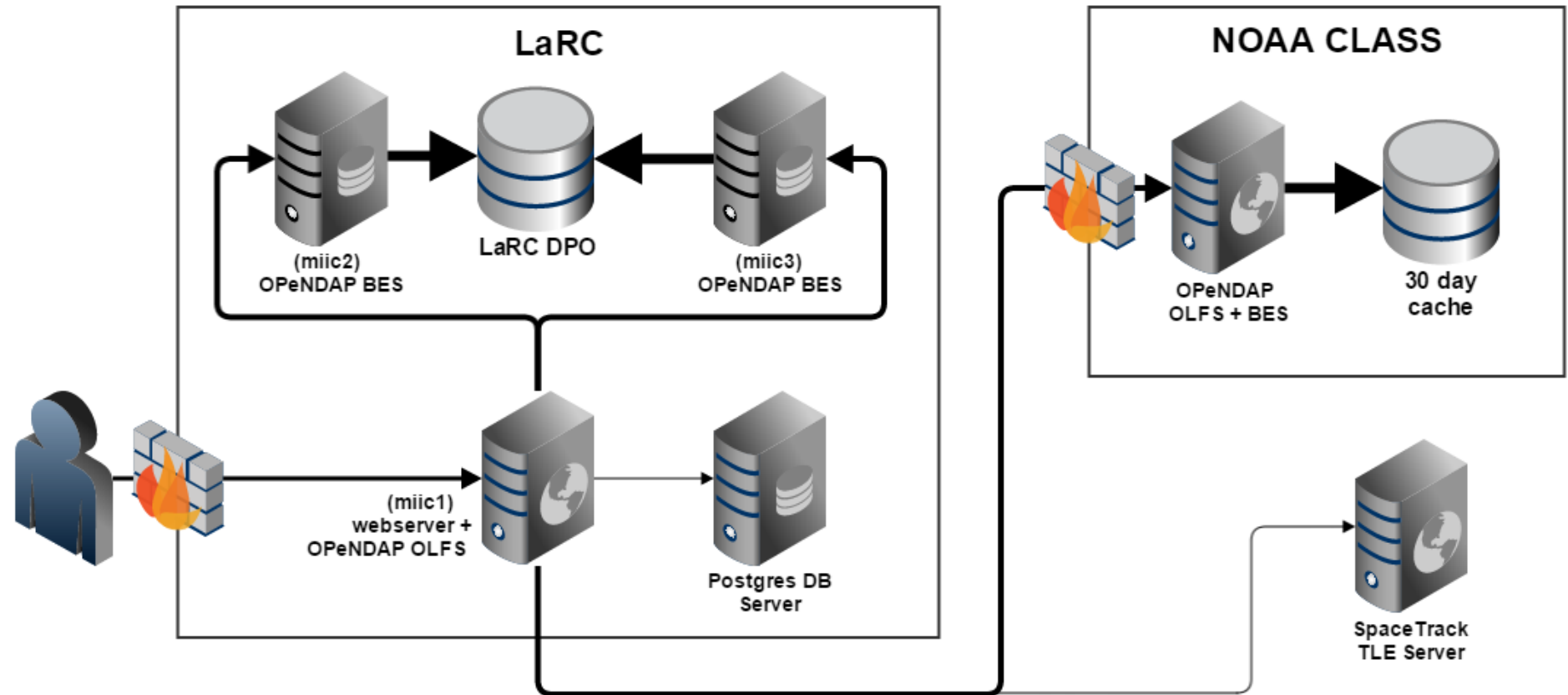
Chris Currey, Costy Lukashin, Aron Bartle

April 22, 2015

MIIC Project

- A ROSES ACCESS 2013 project (2 years) to deploy web services at NOAA NCDC and NASA ASDC to improve access to select data products in support of intercalibration and intercomparison studies

MIIC Deployment Plan



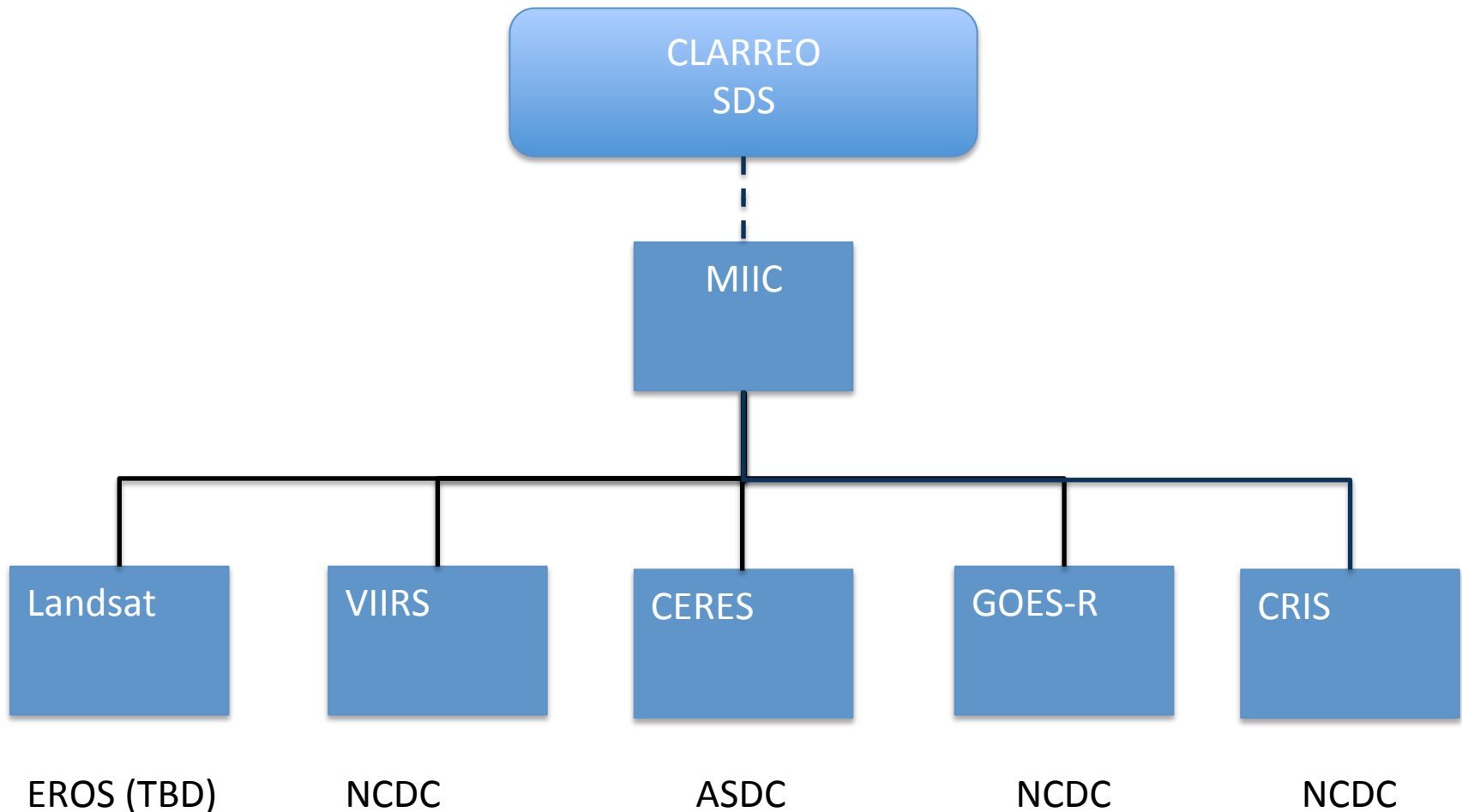
MIIC Objectives

- Access matched observations (time, view angles) from multiple satellite instruments within large datasets distributed across multi-agency data centers
- Filter large data products within server-side functions at remote centers prior to network transmission
- Support GSICS, Cal-Val and CLARREO teams
- Demonstrate benefit of OPeNDAP server-side functions
- Demonstrate successful deployment of a NOAA and NASA collaborative distributed data system
- Demonstrate feasibility of accessing remote hyperspectral OSSE datasets for comparison with observations

Future MIIC Opportunities

- Deploy MIIC-OPeNDAP module at GSFC LAADS, access L1 and L2 MODIS data and reprocessed VIIRS SDR and EDR (Atmospheres) (*E. Masuoka*)
- Deploy MIIC-OPeNDAP module at GSFC DAAC, access L1 and L2 AIRS data and reprocessed CRIS data (*S. Kempler*)
- Deploy MIIC OPeNDAP server(s) at EUMETSAT, access Metop-A,B (*P. Miu, T. Hewison*)
- Provide MIIC link on the Earth Data Web portal (<http://earthdata.nasa.gov>)
- Serve as basis for Reference Intercalibration architecture for CLARREO Pathfinder (2016 – 2021)

MIIC Infrastructure to Support CLARREO Pathfinder Reference Intercalibration



Data Products for Initial MIIC Deployment

Product	Center	Type	Temporal Coverage	Size
CERES L2	ASDC	Footprints	hour	50 MB
CALIPSO L1	ASDC	Profile	orbit	500 MB
CALIPSO L2	ASDC	Layer, Profile, and VFM	orbit	40-108 MB
CRIS SDR	NCDC	Spectra	6.8 min	257 MB
ATMS SDR	NCDC	Swath scans	7 min	2.6 MB
VIIRS SDR	NCDC	Swath scans	5 min	350 MB
VIIRS EDR	NCDC	Aerosol, Cloud, Ice, Land, Sea Surface,... 14 types	~ 5.8 min	1.1- 9 MB
GOES13	NCDC	Full disk scans	15 min.	2.7 GB

- Sizes are approximate; temporal and spatial coverage vary with product type
- Geolocation and science data may be in separate files at NCDC (use OPeNDAP NcML)
- VIIRS channels stored in separate files

MIIC Use Cases

- Intercalibration (*LEO-GEO and LEO-LEO*) ✓
 - Acquire and analyze matched data using the MIIC event predictor instrument models
 - Use MIIC OPeNDAP server-side functions to acquire, filter, and grid L1 or L2 data
 - Demonstrated capabilities with SCIAMACHY, MODIS, VIIRS, GOES and CERES
- Intercomparison (*support NPP Validation study*) ✓
 - Acquire matched NPP and CALIPSO data
 - Data used for offline validation of CriMSS (T, H₂O) using RTM (X. Liu)
 - Acquire CrIS SDR, ATMS SDR, VIIRS SDR, VIIRS EDR, CriMSS EDR, CALIPSO L1 & L2 data for matched events
- Surface Site Data Mining ✓
 - Acquire data over geographic surface sites (eg., Libya-4, Dome C)
 - Use MIIC OPeNDAP server-side functions to acquire, filter, and grid L1 or L2 data
 - For CERES and CALIPSO use ASDC PostGIS to speed up predictions
- OSSE Data Access (*support OSSE vs. SCIAMACHY analysis*)
 - Demonstrate efficient access to large hyperspectral multi-year OSSE datasets
 - Develop spectral resample and spatial average server-side functions
 - OSSE vs. SCIAMACHY offline analysis (Y. Roberts)

What can you do with MIIC?

- Event Prediction ✓
- Acquisition of matched events ✓
- Analysis and visualization of events

Type	Target	Reference	Date range	Performance	Volume Processed
Event prediction	GOES13 FD	NPP VIIRS	2013	1492 events, 30 sec.	N/A
Event prediction	Aqua MODIS	NPP VIIRS	2013	948 events, 1 min.	N/A
LEO-GEO 2DGridded	GOES13 FD	NPP VIIRS	Jan. 1, 2013	4 events, 5 min.	14 GB
LEO-GEO Tuple	GOES13 FD	NPP VIIRS	Jan. 1, 2013	4 events, 7 min.	14 GB
LEO-LEO 2DGridded	Aqua CERES	NPP VIIRS	Jan., 2013	27 events, 4 min.	40 GB
LEO-LEO Tuple	NPP VIIRS	CALIPSO	Aug. 12, 2013	1 event, 2 min.	4 GB
Surface Site Tuple	NPP VIIRS	N/A	2014	274 events, 18 min.	100 GB
Surface Site Tuple	CALIPSO	N/A	2013	182 events, 4 min.	91 GB
Surface Site 2DGridded	NPP VIIRS	N/A	2014	274 events, 18 min.	100 GB

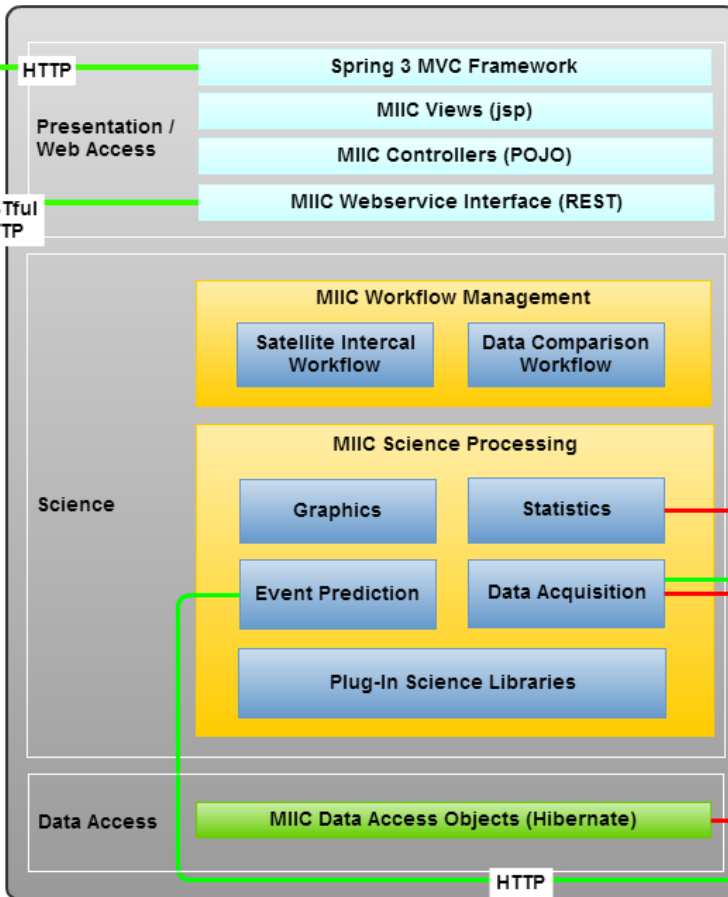
All products staged on ASDC servers, surface site (10 degree box at 75 W), data volumes are approximate

MIIC Architecture

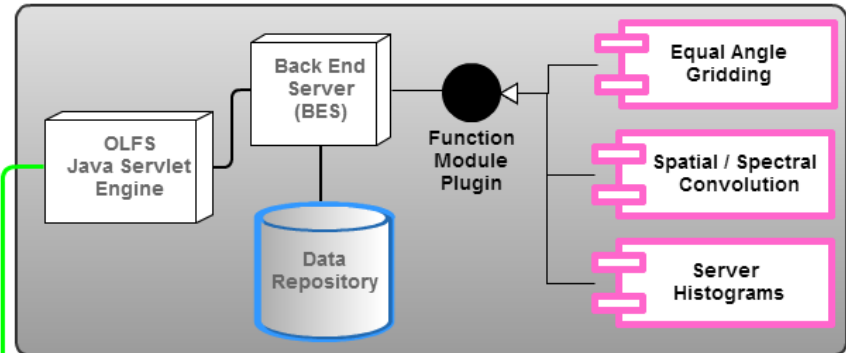
Client/UI Tier



Application Server Tier



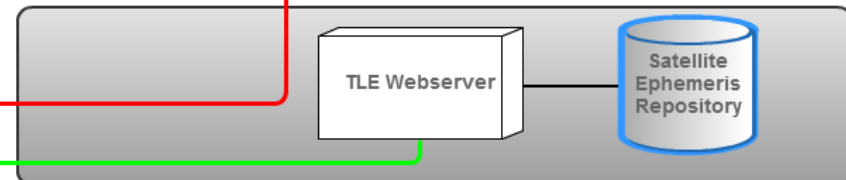
OPeNDAP Data Tier(s)



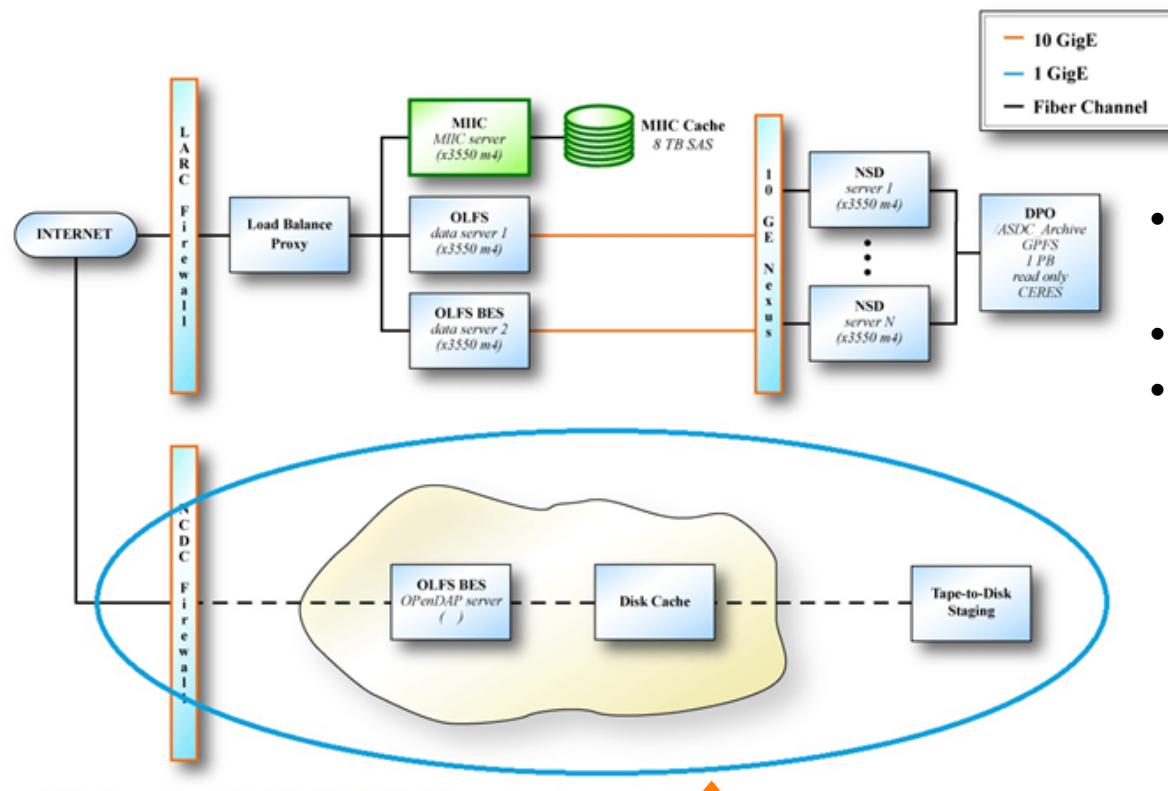
Local Data Tier



TLE Server



NOAA - NASA Collaborative Deployment














- New SGI servers installed at ASDC
- 10 GE connectivity to DPO
- Still need to provide Internet access

Attempting to provide dedicated MIIC S-NPP 30 Day Cache w/ OPeNDAP access

S-NPP MIIC 30 Day Cache

Index of <ftp://ftp-npp.class.ngdc.noaa.gov/20150114/>

 [Up to higher level directory](#)

Name	Size	Last Modified
 ATMS-SDR		1/14/15 8:00:00 AM
 ATMS-TDR		1/14/15 8:15:00 AM
 CRIS-SDR		1/14/15 10:01:00 AM
 OMPS-EDR		1/14/15 9:15:00 AM
 OMPS-IP		1/14/15 9:45:00 AM
 OMPS-RDR		1/14/15 9:46:00 PM
 OMPS-SDR		1/14/15 9:30:00 AM
 VIIRS-EDR		1/14/15 1:12:00 PM
 VIIRS-IPNG		1/14/15 2:00:00 PM
 VIIRS-SDR		1/14/15 3:49:00 PM
 VIIRSI-EDR		1/14/15 12:17:00 PM

- Submitted request to NOAA for NPP file types
- ATMS, VIIRS, and CRIS products (19 TB/mo.)
- Current ftp server not setup for OPeNDAP, files need to be untarred and uncompressed, <ftp://ftp-npp.class.ngdc.noaa.gov/>
- NCDC to stand up dedicated 30 day MIIC cache with OPeNDAP access (*J. Morris, L. Crandall*)

Index of <ftp://ftp-npp.class.ngdc.noaa.gov/20150114/VIIRS-SDR/>

 [Up to higher level directory](#)

Name	Size	Last Modified
 VIIRS-Day-Night-Band-SDR		1/15/15 3:47:00 PM
 VIIRS-Day-Night-Band-SDR-Ellipsoid-Geo		1/15/15 3:46:00 PM
 VIIRS-Image-Bands-SDR-Ellipsoid-Geo		1/15/15 3:46:00 PM
 VIIRS-Image-Bands-SDR-Ellipsoid-Terrain-Corrected-Geo		1/15/15 3:50:00 PM
 VIIRS-Imagery-Band-01-SDR		1/15/15 3:48:00 PM
 VIIRS-Imagery-Band-02-SDR		1/15/15 3:48:00 PM
 VIIRS-Imagery-Band-03-SDR		1/15/15 3:50:00 PM
 VIIRS-Imagery-Band-04-SDR		1/15/15 3:46:00 PM
 VIIRS-Imagery-Band-05-SDR		1/15/15 3:46:00 PM
 VIIRS-Moderate-Bands-SDR-Geo		1/15/15 3:49:00 PM
 VIIRS-Moderate-Bands-SDR-Terrain-Corrected-Geo		1/15/15 3:45:00 PM
 VIIRS-Moderate-Resolution-Band-01-SDR		1/15/15 3:51:00 PM
 VIIRS-Moderate-Resolution-Band-02-SDR		1/15/15 3:48:00 PM
 VIIRS-Moderate-Resolution-Band-03-SDR		1/15/15 3:45:00 PM
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 VIIRS-Moderate-Resolution-Band-06-SDR		1/15/15 3:47:00 PM
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 VIIRS-Moderate-Resolution-Band-08-SDR		1/15/15 3:44:00 PM
 VIIRS-Moderate-Resolution-Band-09-SDR		1/15/15 3:51:00 PM
 VIIRS-Moderate-Resolution-Band-10-SDR		1/15/15 3:45:00 PM
 VIIRS-Moderate-Resolution-Band-11-SDR		1/15/15 3:44:00 PM
 VIIRS-Moderate-Resolution-Band-12-SDR		1/15/15 3:48:00 PM
 VIIRS-Moderate-Resolution-Band-13-SDR		1/15/15 3:49:00 PM
 VIIRS-Moderate-Resolution-Band-14-SDR		1/15/15 3:51:00 PM
 VIIRS-Moderate-Resolution-Band-15-SDR		1/15/15 3:49:00 PM
 VIIRS-Moderate-Resolution-Band-16-SDR		1/15/15 3:47:00 PM

1 MIIC Web Page Demo

Intercalibration Plan

Intercalibration Plan Event Prediction Options Data Collection Options

Plan Name

Owner

Target Data Collection

Reference Data Collection

Begin date

End date

[Save Plan](#)

[Home](#)

[View Logs](#)

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Intercalibration Plan

Intercalibration Plan Event Prediction Options Data Collection Options

No Data Collection 2D Histogram Averages Full-resolution N-Tuples Spatial/Spectral Convolution

Target Variables Target variable dimensions

Reference Variables Reference variable dimensions

Advanced Options

[Save Plan](#)

[Home](#)

[View Logs](#)

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Intercalibration Plan

Intercalibration Plan Event Prediction Options Data Collection Options

Leo vs. Leo Leo vs. Geo Leo vs. Ground Station ASDC Ground Predictor

dt

razmax

referenceSwath

sunsodeg

szmax

targetSwath

twindow

vzmax

[Save Plan](#)

[View Logs](#)

User creates
ICPlans to predict,
acquire, and
analyze data

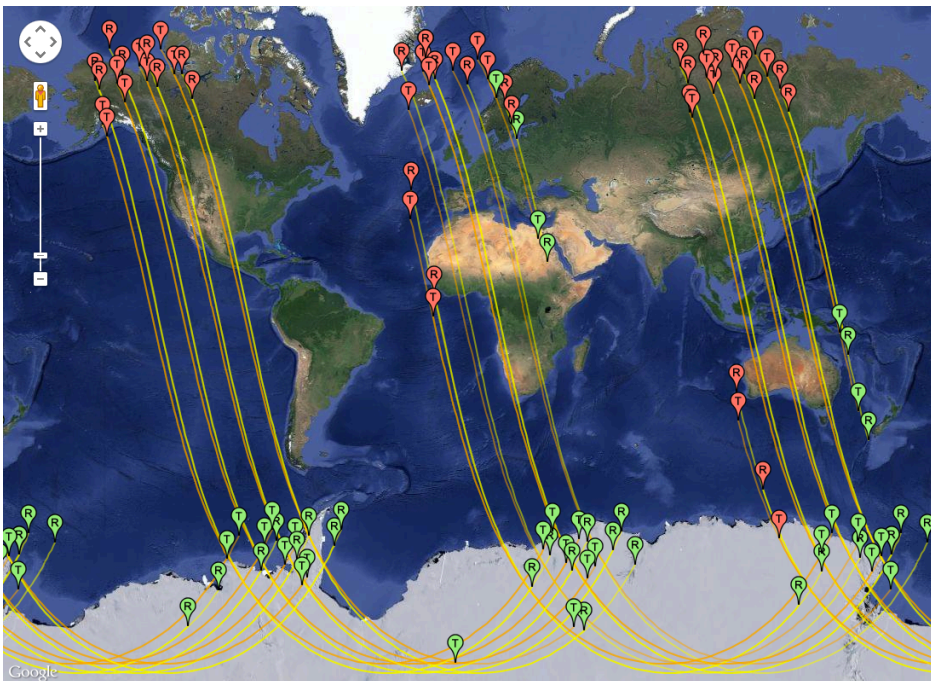


Plan: CERES_Aqua-NPP_VIIRS-dsrun

Current State: ACQUIRING_DATA

[Start Execution](#)

Show	10	entries						Search: <input type="text"/>
	Begin	End	Lat South	Lat North	Lon West	Lon East	State	
+	Fri, 24 Jan 2014 13:59:35 GMT	Fri, 24 Jan 2014 14:28:38 GMT	-89.00324197697755	-2.269774608270527	-179.9761271374854	179.96991327080818	DATA_ACQUIRED	
+	Mon, 27 Jan 2014 03:12:34 GMT	Mon, 27 Jan 2014 03:44:32 GMT	-40.79488007908672	71.49217490581624	93.67320698173019	176.74090509262373	DATA_ACQUIRED	
+	Mon, 27 Jan 2014 04:35:32 GMT	Mon, 27 Jan 2014 05:24:59 GMT	-88.99962790759989	69.95656783254812	0.37544132975204914	-0.05534390474684869	DATA_ACQUIRED	
+	Mon, 27 Jan 2014 06:16:47 GMT	Mon, 27 Jan 2014 06:27:00 GMT	-88.9996738904554	-60.816009775757145	0.07700780640099117	-0.6418072707076021	DATA_ACQUIRED	
+	Wed, 29 Jan 2014 19:13:21 GMT	Wed, 29 Jan 2014 20:01:43 GMT	-88.99989074878894	72.18100616579439	-179.34322853682022	179.8608894261324	DATA_ACQUIRED	
+	Wed, 29 Jan 2014 20:52:28 GMT	Wed, 29 Jan 2014 21:41:41 GMT	-88.99990601738796	68.98370623285292	-179.65961033892637	179.66108203012388	DATA_ACQUIRED	
Showing 21 to 26 of 26 entries								
Previous 1 2 3 Next								



- Event Prediction results depicted on Google Maps
- Need to develop analysis and visualization capabilities for single events and collections of events

TLEs Available for MIIC Event Prediction

(red implemented)

- Can run predictions for any spacecraft with TLEs from Space-Track.org
- Current plans to access only instrument data hosted at ASDC or NCDC
- User can run predictions w/o accessing data
- Extend list of satellites in current deployment?
Run IC and access only data from 1 satellite
- Extended CLARREO algorithm (*C. Roithmayr*)

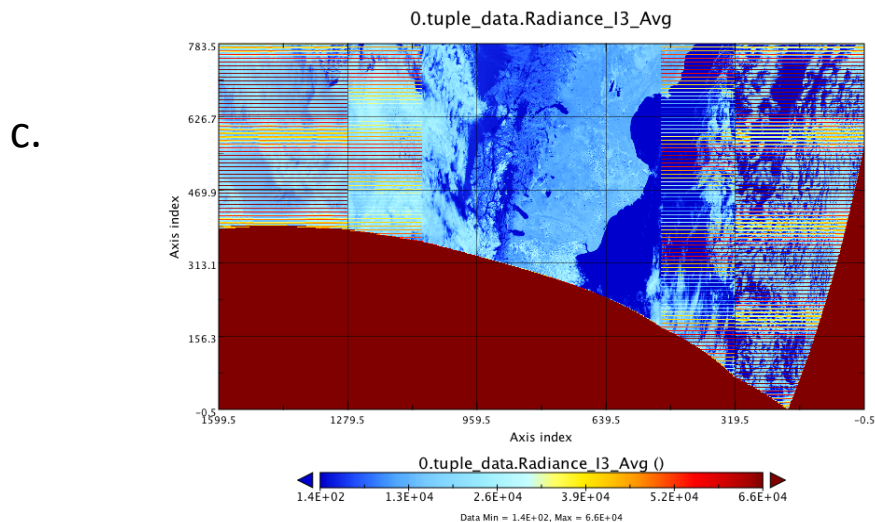
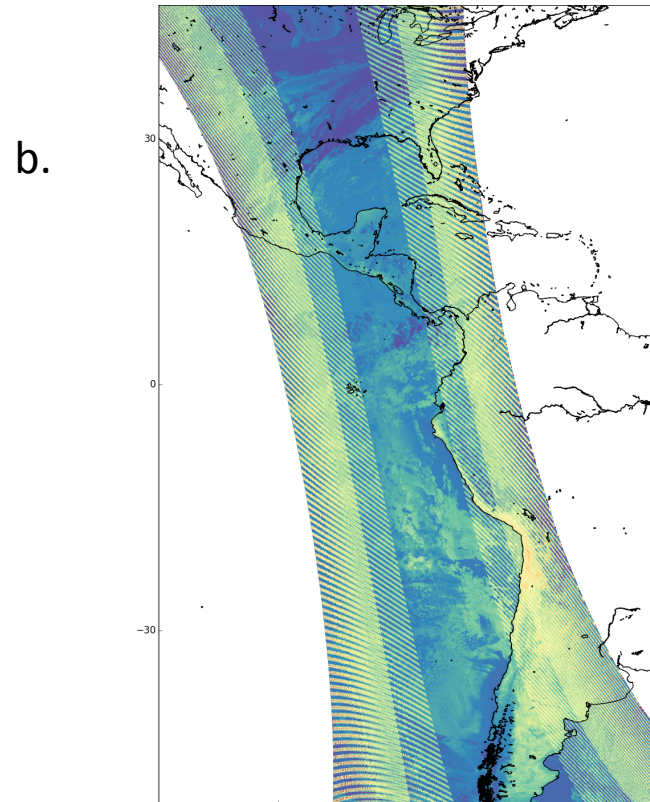
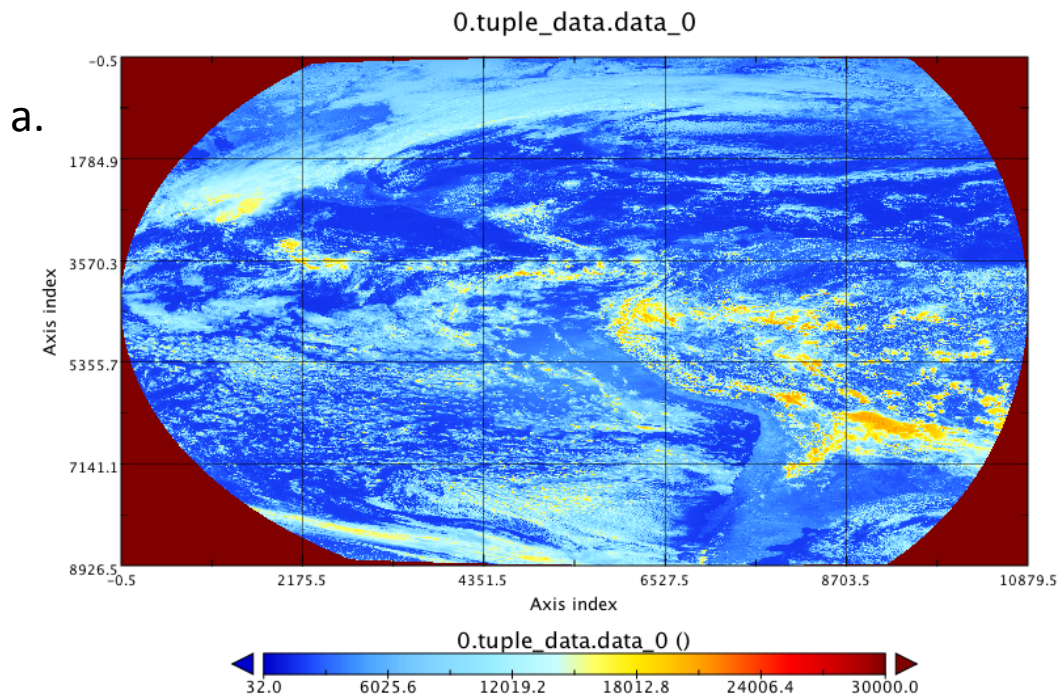
<http://www-angler.larc.nasa.gov/cgi-bin/site/showdoc?mnemonic=TLE&c=satellite-list>

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14780	"Landsat 5"	"2013-06-20 08:05:02"
15354	"ERBS"	"2013-06-20 08:05:02"
15427	"NOAA-09"	"2013-06-20 08:05:02"
16969	"NOAA-10"	"2013-06-20 08:05:02"
19531	"NOAA-11"	"2013-06-20 08:05:02"
21140	"Meteosat-5"	"2013-06-20 08:05:02"
21263	"NOAA-12"	"2013-06-20 08:05:02"
21574	"ERS-1"	"2013-06-20 08:05:02"
23051	"GOES-8"	"2013-06-20 08:05:02"
23455	"NOAA-14"	"2013-06-20 08:05:02"
23522	"GMS-5"	"2013-06-20 08:05:02"
23560	"ERS-2"	"2013-06-20 08:05:02"
23581	"GOES-9"	"2013-06-20 08:05:02"
23940	"TOMS-EP"	"2013-06-20 08:05:02"
24786	"GOES-10"	"2013-06-20 08:05:02"
24883	"OrbView-2"	"2013-06-20 08:05:02"
24932	"Meteosat-7"	"2013-06-20 08:05:02"
25063	"TRMM/VIRS"	"2013-06-20 08:05:02"
25260	"SPOT-4"	"2013-06-20 08:05:02"
25338	"NOAA-15"	"2013-06-20 08:05:02"
25682	"Landsat 7"	"2013-06-20 08:05:02"
25789	"QuikSCAT"	"2013-06-20 08:05:02"
25991	"DMSP 5D-3 F15 (USA 147)"	""
25994	"Terra"	"2013-06-20 08:05:02"
26352	"GOES-11"	"2013-06-20 08:05:02"
26536	"NOAA-16"	"2013-06-20 08:05:02"
26871	"GOES-12"	"2013-06-20 08:05:02"

27386	"EnviSAT"	"2013-06-20 08:05:02"
27421	"SPOT-5"	"2013-06-20 08:05:02"
27424	"Aqua"	"2013-06-20 08:05:02"
27453	"NOAA-17"	"2013-06-20 08:05:02"
27509	"Meteosat-8 (MSG-1)"	"2013-06-20 08:05:02"
27525	"Kalpana-1"	"2013-06-20 08:05:02"
27642	"ICESat"	"2013-06-20 08:05:02"
28054	"DMSP 5D-3 F16 (USA 172)"	""
28376	"Aura"	"2013-06-20 08:05:02"
28451	"Feng Yun 2C"	"2013-06-20 08:05:02"
28622	"MTSAT-1R"	"2013-06-20 08:05:02"
28622	"MTSAT-1R/Aqua"	"2013-06-20 08:05:02"
28654	"NOAA-18"	"2013-06-20 08:05:02"
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28912	"Meteosat-9/Terra (MSG-2)"	"2013-06-20 08:05:02"
28912	"Meteosat-9/Aqua (MSG-2)"	"2013-06-20 08:05:02"
28937	"MTSAT-2"	"2013-06-20 08:05:02"
29107	"CloudSAT"	"2013-06-20 08:05:02"
29108	"Calipso"	"2013-06-20 08:05:02"
29155	"GOES-13"	"2013-06-20 08:05:02"
29499	"MetOp-A"	"2013-06-20 08:05:02"
29522	"DMSP 5D-3 F17 (USA 173)"	"2011-11-15 08:12:53"
29640	"Feng Yun 2D"	"2013-06-20 08:05:02"
32382	"RadarSat-2"	"2013-06-20 08:05:02"
33463	"FY2E"	"2012-07-12 15:57:39"
33492	"GOSAT"	"2013-06-20 08:05:02"
33591	"NOAA-19"	"2013-06-20 08:05:02"
35951	"DMSP 5D-3 F18 (USA 210)"	""
36411	"GOES-15"	"2013-06-20 08:05:02"
37838	"Megha-Tropiques"	"2013-06-20 08:05:02"
37849	"Suomi National Polar Orbiting Partnership"	"2013-06-20 08:05:02"
38552	"Meteosat-10 (MSG-3)"	"2013-06-20 08:05:02"
38771	"MetOp-B"	"2013-06-20 08:05:02"

LEO-GEO Full Resolution (Tuple) Data for VIIRS vs. GOES13 Event

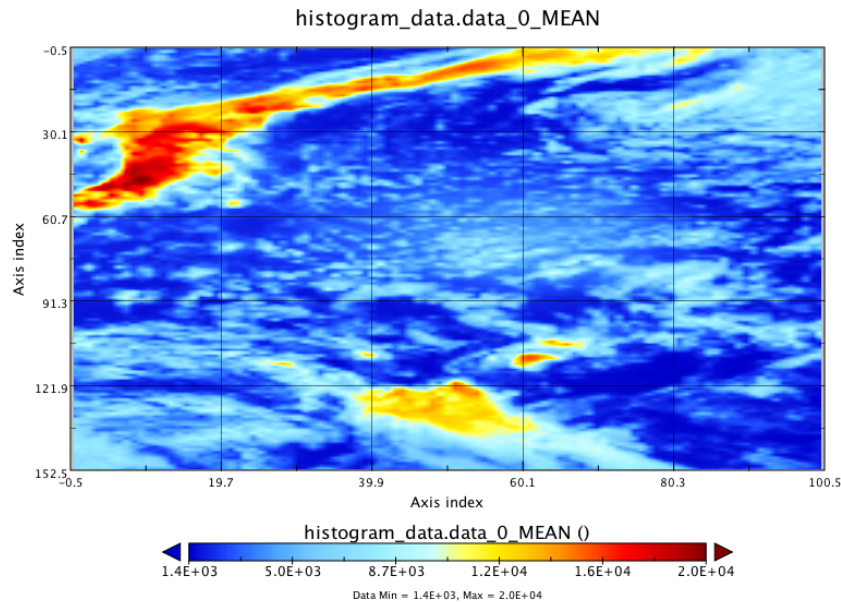
Jan. 1, 2013



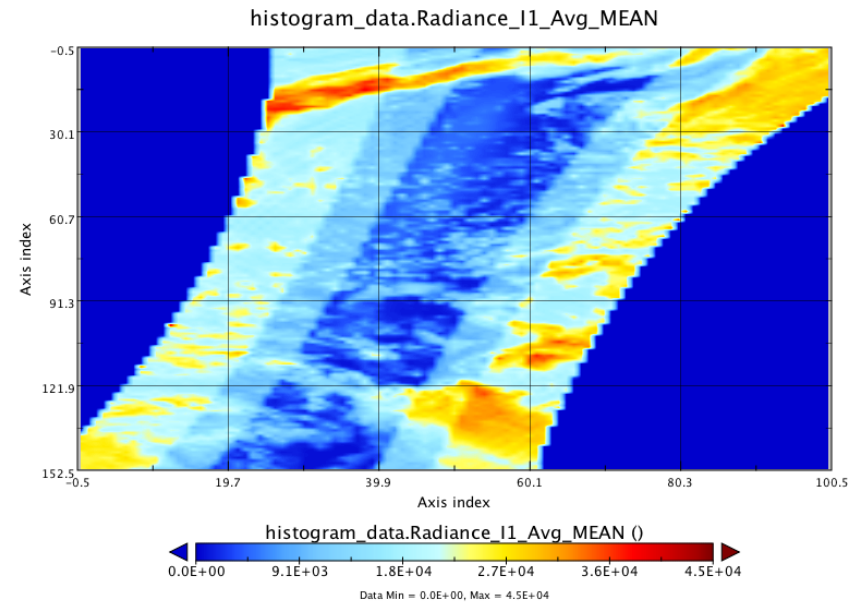
Jan. 1, 2013 NPP VIIRS-GOES13 MIIC IC Event,
46.4 N, -51.2 S, -114.7 W, -53.2 W, time 2013-01-01T18:49:40Z
through 2013-01-01T19:17:00Z; **a.** 1 km GOES13 band 0 data from
CLASS, **b.** Matched 2 km VIIRS SDR Radiance_I3_Avg data, **c.** one
VIIRS granule (of 7) that make up matched LEO-GEO event; fill values
at scan angles greater than 31.7° and 56.3° due to “bow-tie” effect.
Extremely large amount of data for a single event!

LEO-GEO Gridded Data for VIIRS vs. GOES13 Event

Jan. 1, 2013



GOES13 gridded



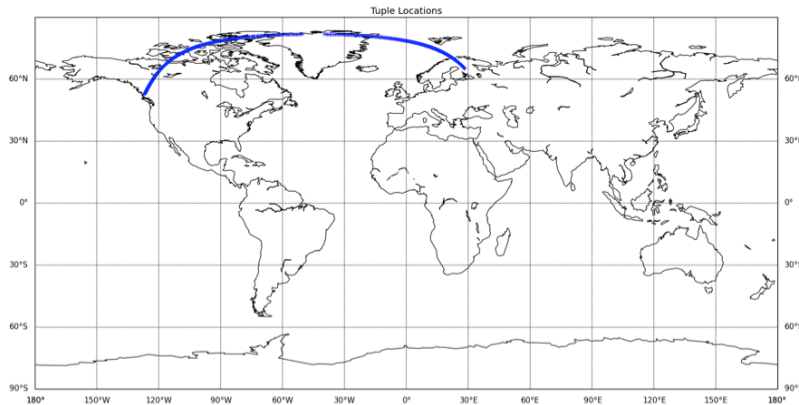
VIIRS gridded

Gridded data, 0.5 degree, returned from MIIC server-side 2DHistogram function for single LEO-GEO matched event; factor of 3500 in data reduction compared to tuple data

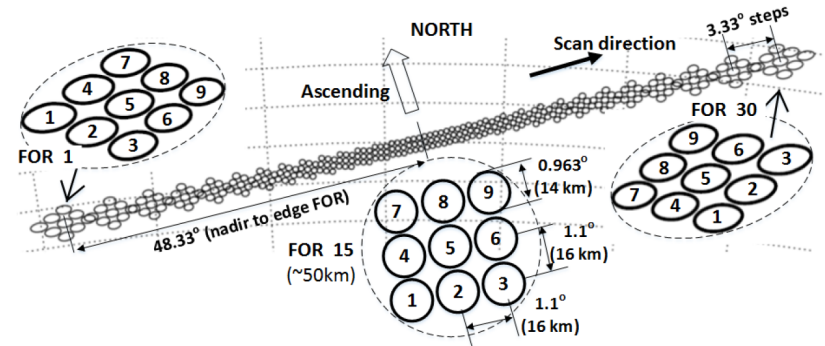
LEO-LEO Intercomparison for CrIMSS Validation Study (X. Liu)

Acquire CALIPSO, CrIS, ATMS, VIIRS, and CrIMISS Tuple Data - *Not Collocated*

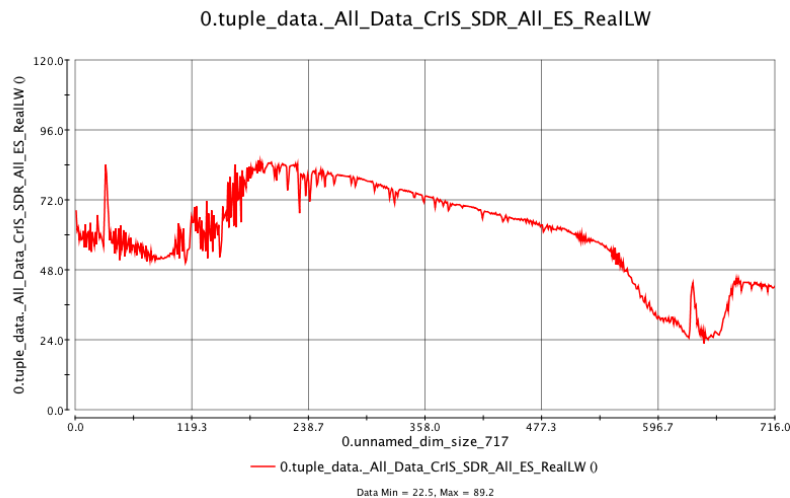
IC Event Aug. 12, 2014



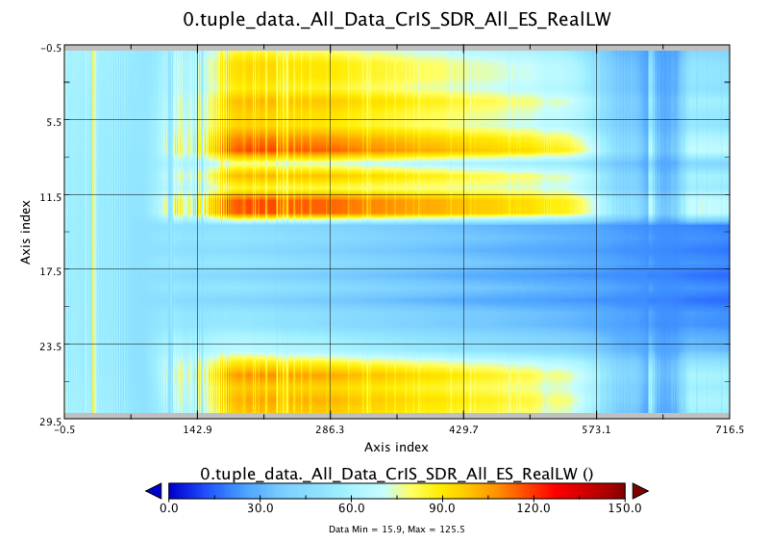
CALIPSO groundtrack for matched event w/ NPP



Tune MIIC event predictor to use CrIS scan width



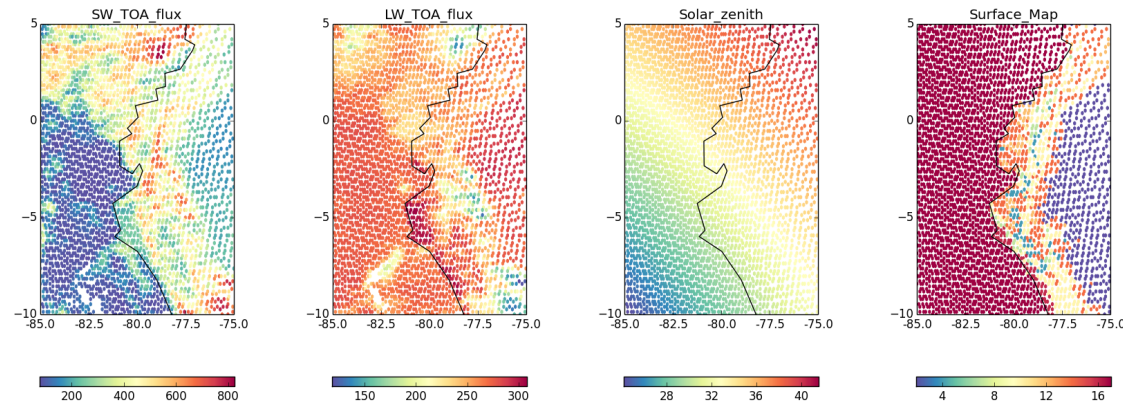
Single CrIS SDR LW spectra for FOV1



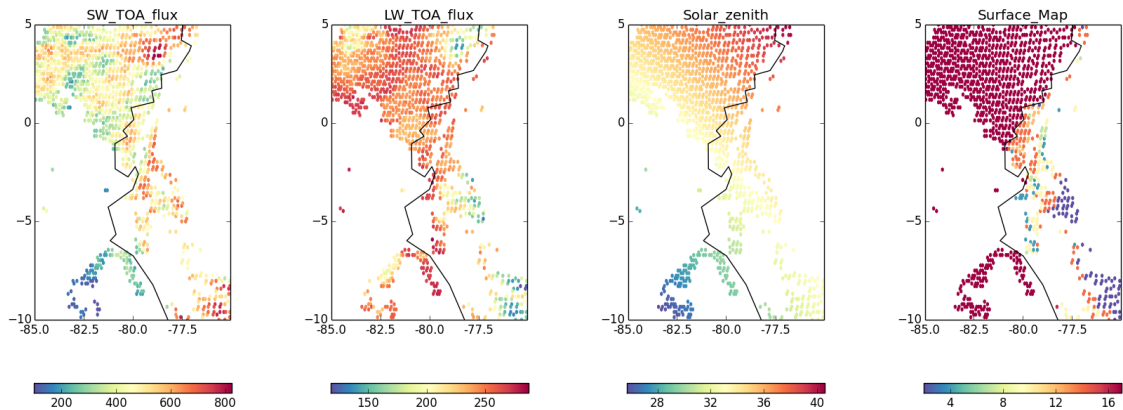
Single scan of CrIS LW spectra for FOV1 (30 FORs per scan)

Server-side Filtering for Surface Site Acquisition

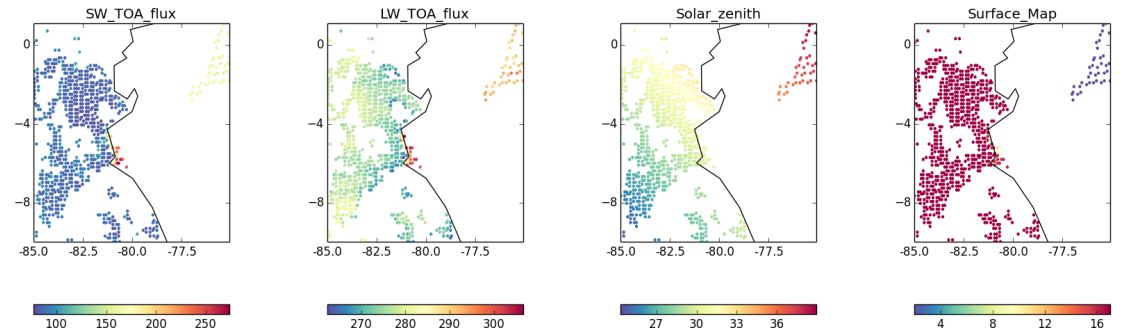
CERES SSF data, Jan. 2, 2011



a. No clear sky filter



b. 5 % clear sky filter



c. 95 % clear sky filter

Deployment Status

- Conducted review with ASDC; presented implementation requirements, design, and integration status
- Defined L2 WBS and draft L3 tasks; still need integrated schedule with ASDC and NCDC concurrence
- MIIC software is ready for initial deployment (rpms built to simplify deployment at NCDC)
- ASDC hardware is in place; need to open up firewall to Internet
- NCDC hardware still TBD; planned 30 day dedicated MIIC cache + OPeNDAP server

Issues

- Need integrated schedule
- Need MOU and Interconnection Security Agreement with NCDC
- ROSES ACCESS proposal not mechanism for data system upgrades (hardware at NCDC TBD)
- EUMETSAT has requested software for evaluation; will require NASA Software Release